

controller is coupled to the first and the second conductive sheets. The touch screen controller drives one of the first and second conductive sheets with an electrical signal referenced to the other of the first and second conductive sheets and measures capacitive current flow between the first and second conductive sheets. A display is disposed below the touch screen for displaying information.

[0012] Another embodiment of the invention is directed to a system for sensing a location of a touch on a touch sensor. The system includes means for sensing a change in capacitance between a first transparent, conductive sheet and a second transparent, conductive sheet when at least a portion of the first transparent, conductive sheet is moved towards the second transparent, conductive sheet. The system also includes means for determining the two-dimensional location of the touch from signals derived from the change in capacitance between the two transparent conductive sheets.

[0013] The above summary of the present invention is not intended to describe each illustrated embodiment or every implementation of the present invention. The figures and the detailed description which follow more particularly exemplify these embodiments.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

[0015] **FIG. 1A** schematically illustrates a cross-section of the conductive layers of a touch sensor in accordance with an embodiment of the invention;

[0016] **FIG. 1B** schematically illustrates a cross-section of the conductive layers of a touch sensor with the top layer deflected toward the bottom layer in accordance with an embodiment of the invention.

[0017] **FIG. 2A** schematically illustrates a cross-section of a touch sensor with two protective dielectric layers and spacers in accordance with an embodiment of the invention;

[0018] **FIG. 2B** schematically illustrates a cross-section of a touch sensor with one protective dielectric layer and spacers in accordance with an embodiment of the invention;

[0019] **FIG. 2C** schematically illustrates a cross-section of a touch sensor with spacers;

[0020] **FIG. 3A** schematically illustrates a cross-section of a touch sensor with a top protective layer, a bottom protective layer with integrated spacers and anti-Newton's rings textures in accordance with an embodiment of the invention;

[0021] **FIG. 3B** schematically illustrates a cross-section of a touch sensor with a bottom protective layer with integrated spacers and anti-Newton's rings textures in accordance with an embodiment of the invention;

[0022] **FIG. 4A** schematically illustrates a cross-section of a touch sensor with a top and a bottom protective layer in accordance with an embodiment of the invention;

[0023] **FIG. 4B** schematically illustrates a cross-section of a touch sensor with a one protective layer in accordance with an embodiment of the invention;

[0024] **FIG. 4C** schematically illustrates a cross-section of a touch sensor in accordance with an embodiment of the invention;

[0025] **FIG. 5** is a block diagram illustrating a touch sensor and 5-wire controller in accordance with an embodiment of the present invention;

[0026] **FIG. 6** is a block diagram illustrating a touch sensor and 4-wire controller in accordance with an embodiment of the present invention;

[0027] **FIG. 7** schematically illustrates a touch sensor used with a simplified controller in accordance with an embodiment of the invention; and

[0028] **FIG. 8** is a block diagram of a data processing system using a touch sensing interface in accordance with an embodiment of the invention.

[0029] While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

#### DETAILED DESCRIPTION

[0030] In the following description of the illustrated embodiments, references are made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration, various embodiments by which the invention may be practiced. It is to be understood that other embodiments may be utilized, and structural and functional changes may be made without departing from the scope of the present invention.

[0031] As stated above, and for other reasons stated below which will become apparent upon reading the present specification, there is a need for a durable touch sensor that reliably and accurately detects the location of a touch independent of the touching implement used. There exists a further need for such a touch sensor with improved optical characteristics and durability. There exists a further need for a touch sensor that can be used with simplified control circuitry.

[0032] The present invention provides, among other things, a touch sensor designed to increase optical transmission through the sensor. In addition, the durability of the touch sensor is enhanced because sensor operation does not require actual contact between conductive layers, thereby reducing mechanical degradation that results from resulting from the conductive layers rubbing, sticking or flaking off, and from chemical interaction with other materials. Because the touch sensing device of the present invention does not depend on a capacitively coupled external path to earth ground, a simplified controller may be used incorporating an internal low impedance reference connection. The touch sensor may be employed in a variety of data processing applications, including those requiring a portable touch screen. The touch sensor of the present invention is touch instrument independent, and may be operated by touching with a finger, gloved finger, fingernail or other nonconduc-